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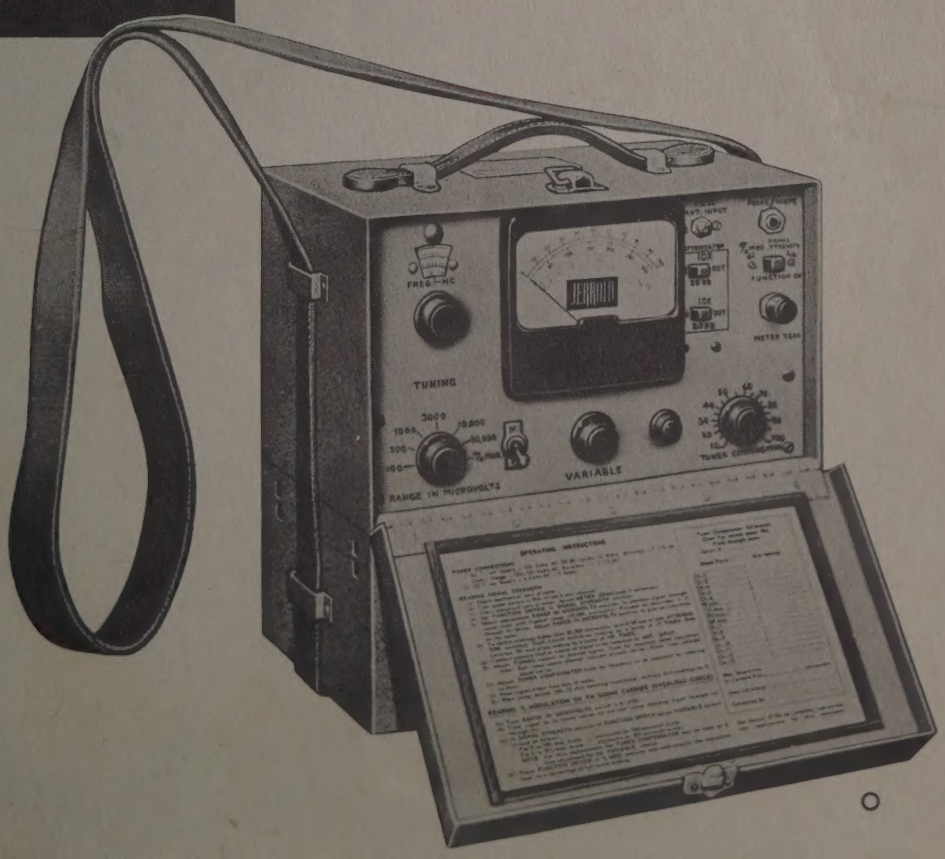

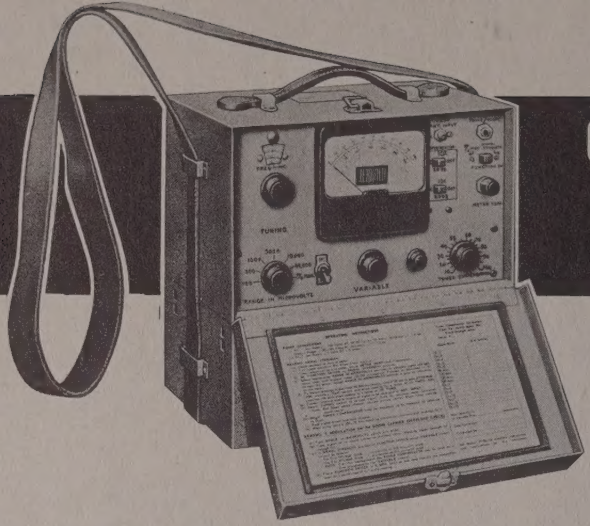

OPERATING AND MAINTENANCE

FIELD STRENGTH METER MODEL 704B

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GENERAL DESCRIPTION

The Jerrold Model 704B, direct reading Field Strength Meter, is a high quality, versatile and portable instrument, for making measurements of signal strengths within the frequency range of 54 to 220 megacycles/sec.

1. APPLICATIONS

The versatility of this instrument is illustrated by a partial list of its applications:

1. Field intensity surveys
2. Balancing Master Antenna Systems
3. Determining overload (sync clipping) in RF amplifiers
4. To check % modulation of AM signal
5. Antenna pick-up or radiation pattern studies
6. Measuring radiation of industrial equipment
7. Determination of attenuation in coaxial cable
8. Checking random noise levels
9. Locating and orienting antennas
10. Measuring and locating interference
11. Individual video and audio carrier level measurements
12. Checking output of signal generators
13. Tuning guide for adjusting interference traps

2. RANGE OF MEASUREMENT

(a) The overall range of the instrument is 5 microvolts (uv) to 3 volts. Six ranges are fundamental and selected by a range switch, (0-100 uv, 0-300 uv, 0-1000 uv, 0-3000 uv, 0-10,000 uv, 0-30,000 uv). The four high ranges, (0-100,000 uv, 0-300,000 uv, 0-1 volt and 0-3 volts), are obtained with the accurate RF attenuator built into the input circuit of the instrument.

(b) RANGE ADJUSTMENT

Internal adjustments are provided for individual calibration of each of the six fundamental ranges, independently of each other. If any range goes out of adjustment it does not affect the other fundamental ranges. Likewise, any error in a lower range is non-accumulative and does not multiply in the higher fundamental ranges.

(c) ATTENUATOR

The attenuator consists of two precision 20 DB pads that can be switched In or Out, individually, or in cascade. Advantages of using the attenuator for laboratory precision measurements are discussed in Sections II and III.

(d) METER

The meter dial is calibrated in two scales, a "0-100" scale with 50 divisions and a "0-300" scale (extended to 316) with 30 divisions. Both scales are direct-reading in microvolts in conjunction with the range selection switch and attenuator settings. Readings as low as 5 microvolts can be made accurately and simply. The entire meter-dial-face is illuminated for ease in night readings.

(e) DB AND DBJ SCALE

All ranges on the meter are coordinated with a db scale on the dial and a DBJ scale on the range switch. Any amplifier signal level can easily be adjusted to another level, so many DB above or below a reference. DB gains of amplifiers, and losses of attenuators, cable, etc., can be read directly from the DB scale in conjunction with the range switch.

Signal levels can easily be read from the meter in DBJ by referring to the DBJ scale. Reference for DBJ is: O DBJ = 1,000 microvolts (uv). (See Section III, Operation.)

(f) PERCENT-MODULATION MEASUREMENTS

A percent-modulation measuring circuit in the instrument permits reading the % Mod. of AM signal generators. The overload characteristics of RF amplifiers can also be determined. (See Section III, Operation.)

3. TUNER AND FREQUENCY DIAL

(a) TUNER

A special type of continuous-tuner is used in this instrument. The tuner is designed for increased selectivity, 75 ohm impedance match, and uniform gain as required for accuracy. The tuner gain variation is less than 3 DB from 54 to 220 mc. The tuner also contains an adjacent channel trap for both adjacent picture and adjacent sound. Adjacent channels are attenuated 60 db.

(b) TUNER COMPENSATOR

To further increase the accuracy of the instrument, a built-in tuner-compensator circuit with external control, has been hand-calibrated. A calibration chart is furnished with each instrument. The tuner-compensator eliminates the gain variation of the tuner as a source of error.

(c) ANTENNA INPUT

The instrument is designed for use with 75 ohm coaxial cable. A 300 to 75 ohm flat-response transformer is supplied for matching 300 ohm line. When using the transformer, microvolt readings must be multiplied by two (2).

(d) FREQUENCY AND CHANNEL DIAL

This specially designed dial is calibrated in both frequency (megacycles/sec.) and television channels (2-13). The relative picture and sound carrier locations for each channel are indicated above the channel number markings. (The red line designating picture carrier and the black line, sound carrier.) The dial is illuminated for ease in reading.

4. ACCURACY

The overall accuracy of this instrument is held to $\pm$ 2 DB in final testing and calibration. Calibration is made at 117 V, 50/60 cps AC.

The accuracy remains better than $\pm$ 3 DB when using the instrument over a range of line voltages from 105-125 volts. These are excellent characteristics for this type of instrument and are the result of the painstaking care with which the circuit was designed.

5. POWER SUPPLY

The Jerrold Model 704B is designed for 117 V, 50/60 cps AC. Power consumption is 55 watts.

6. PHONE OUTPUT JACK

The phone jack on the front panel permits connection of ear phones through a standard PL-55 type phone plug. The use of ear phones aids in the identification of various signals as possible sources of interference (FM stations, Aeronautical, Amateur, etc.). Due to its limited bandwidth, the output from this jack should not be used for the observation of composite video.

7. VIDEO OUTPUT JACK

The video output jack allows for the connection of an oscilloscope to the Model 704B for the observation of composite video. This is very desirable in determining the percentage of "sync" in relation to the overall composite signal.

8. CABINET

Aluminum was chosen for both chassis and cabinet for least weight with maximum durability. The finish is a durable baked-on "Wrinkle" finish of Government specifications. A carrying handle and shoulder-strap may be used in carrying the instrument. A hinged door protects the front panel and houses the instruction sheet and calibration chart for permanent reference.

REFERENCE DATA

FREQUENCY RANGE	54 to 220 mc/sec., covered in one band
INTERMEDIATE FREQUENCY (I.F.)	25 mc/sec.
INPUT IMPEDANCE	75 ohms; 300/75 ohm matching transformer provided
SENSITIVITY	5 microvolts Minimum signal required for full scale deflection with MANUAL GAIN CONTROL maximum position, 60 microvolts.
SELECTIVITY	Bandwidth at 3 DB down 0.6 mc.
IMAGE FREQUENCY RESPONSE	90 DB down from signal level
ADJACENT CHANNEL REJECTION	60 db down from received signal.
POWER SUPPLY REQUIREMENTS	AC—105 to 125 volts, 50 to 60 cps; ½ amp; 55 watts

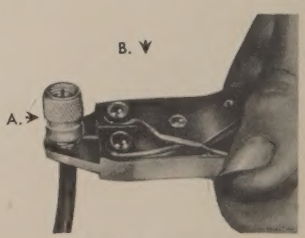
TUBE COMPLEMENT		
	2 5654	1 ..... 6T8
	1 ..... 6AB4	1 ..... 12AU7
	3 5749	1 ..... OD3 (VR-150)
		1 ..... 5V4

PHYSICAL SPECIFICATIONS		
	Height - - 12"	Weight - - 19 pounds
	Width - - 12¾"	
	Depth - - 8"	Shipping Weight—24 pounds

ACCESSORIES FIGURE 1

300-75 OHM*
Matching Transformer

JERROLD manufactures a complete line of solderless coaxial fittings, adapters and connectors for use with all RG-59, RG-11 and RG-35 type cables. For complete information on these fittings and other items in JERROLD Line, write for "JP Catalog No. 1957".



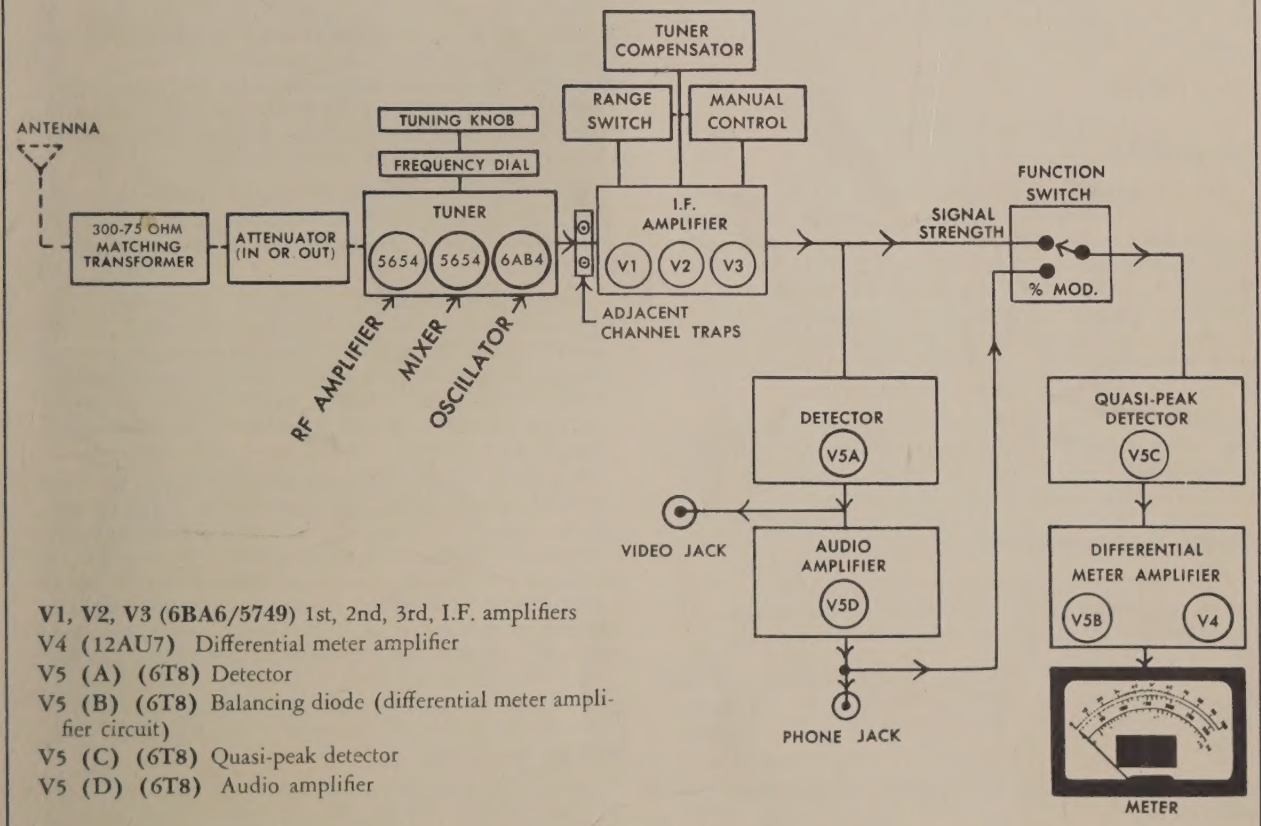
A. Jerrold Solderless Male Cable Connector.
*Model C-52 for RG-59/U
Model C-56 for RG-6/U

B. PL-601 Crimping Tool

* Items shown with asterisk are supplied with meter—other items available on order.

SECTION II

THEORY OF OPERATION



V1, V2, V3 (6BA6/5749) 1st, 2nd, 3rd, I.F. amplifiers
V4 (12AU7) Differential meter amplifier
V5 (A) (6T8) Detector
V5 (B) (6T8) Balancing diode (differential meter amplifier circuit)
V5 (C) (6T8) Quasi-peak detector
V5 (D) (6T8) Audio amplifier

FIGURE 2. BLOCK DIAGRAM MODEL 704B

Section 2 - THEORY

Figure 2 shows the Block Diagram and tube functions of the Model 704B. The following paragraphs deal briefly with the theory of operation.

MATCHING TRANSFORMER:

The 300 to 75 ohm transformer is used with 300 ohm lead-in only; normally 75 ohm coax is run directly into the antenna input on the front panel.

ATTENUATOR:

The attenuator may be switched into the input circuit if readings greater than 30,000 uv are to be read directly. Readings are then multiplied by the attenuator factor.

TUNER

As previously explained, the tuner is of special design to suit this particular instrument. An excellent 75 ohm input impedance match has been achieved in the unit with a VSWR better than 1.06 to 1. This match holds true with or without the input attenuators switched into the circuit. Therefore, it is unnecessary to use an external attenuator pad when measuring signals less than 500 uv from an unknown source.

The tuner contains adjacent channel, picture and sound traps which attenuate the adjacent carriers 60 db below the received signal. This is both desirable and necessary for the accurate measurements of weak signals in the presence of strong adjacent carriers.

I.F. SYSTEM:

The output of the tuner is link-coupled to the I.F. amplifier system. The I.F. is 25 megacycles/sec.

The I.F. system is synchronously tuned for a narrow 0.6 mc bandwidth. Synchronous tuning provides the utmost stability and ease of alignment. The I.F. section is sufficiently stable to permit tube changes without impairing the calibration of the instrument to any serious extent. Synchronous tuning is simple enough to permit peaking of the I.F. response, using an accurate RF signal generator; the meter-movement of the Model 704B itself, serves as the indicating device (See Section IV, Maintenance).

The gain of the 1st and 2nd I.F. stages is controlled by one of seven potentiometers selected by the Range Switch on the front panel. These potentiometers are internally adjusted to calibrate each range (See Section IV).

TUNER COMPENSATOR:

The tuner-compensator-control varies a potentiometer in the cathode circuit of the 3rd I.F. This control is calibrated to compensate for tuner-gain-variation with frequency.

From the I.F. system, the signal divides, the major portion traveling (through the function switch) to the quasi-peak meter detector, and the remainder to the audio detector, audio amplifier and phone jack.

FUNCTION SWITCH IN SIGNAL STRENGTH POSITION:

The signal from the last I.F. stage passes through the quasi-peak detector, (a detector operating at near peak levels to assure that modulation will not affect readings).

From the detector the signal goes to one grid of the differential amplifier tube (12AU7), which actuates the meter movement. (The differential amplifier is a very stable, balanced, DC amplifier circuit with cathode degeneration.)

Meter readings in "Signal Strength" position of the function switch represent peak RF carrier levels.

AUDIO DETECTOR-AUDIO AMPLIFIER-PHONE AND VIDEO JACKS:

The audio detector circuit permits detection of the sound modulation of FM sound carriers. and of the video modulation of TV picture carriers. The detected signal is applied to the Video Output Jack for the observation of composite video. The detected signal is also amplified and can be taken off at the Phone Jack or used to measure percent of amplitude modulation of the carrier.

The detection of an FM sound carrier is explained by the principle of slope detection. In effect the FM carrier is tuned in so that its center frequency falls on the sloping part of the I.F. response curve. This results in a conversion of the frequency variations of the FM signal into amplitude variations, which are detected in the usual manner by the Audio Detector and produce sound in ear-phones connected to the phone-jack.

FUNCTION SWITCH IN % MODULATION POSITION:

Percent-modulation measurements can be made with the Model 704B. The (0-100) and (0-300) range scales have been calibrated as (0-10%) and (0-30%) percent-modulation scales respectively.

The instrument is first operated in "Signal Strength" position and tuned to the exact mean or resting frequency of the FM carrier. With the range switch in "MANUAL GAIN CONTROL" position the manual control is operative as a gain control, and the meter reading is adjusted to the calibration setting on the 0-100 or 0-300 scales (as specified on the operating instruction card).

With the function switch in % Mod. position the meter is read directly as % Mod., i.e., a reading of 50 on the 0-100 scale is 5% Mod a reading of 200 on the 0-300 scale is 20% Mod.

If there is no amplitude modulation of the FM carrier, there will be no reading on the meter, provided that the carrier is tuned exactly to its mean frequency. A check of this point is given in Section III. Calibration points are 5% for the 0-10% scale, and 20% for the 0-30% scale, determined by an amplitude modulated RF-signal-generator as a standard.

This method applies to determining % Mod. of standard amplitude modulated RF-signal-generators, and to measuring "overload" of an amplifier such as a television channel amplifier. In the case of a TV amplifier, overload of input or output results in amplitude modulation of the FM sound carrier by the video carrier. This is 60 cycle AM caused by the vertical sync pulses of the video signal driving the grid of a stage positive and modulating the sound carrier with sync pulses. This is the familiar "buzz" heard from an overloaded television receiver. (For instructions on making % Mod. measurements, see Section III, Operation.)

METER RANGES:

The six fundamental ranges have been described in the previous section. As has been discussed, each range is calibrated with a variable - potentiometer - gain - control adjusted for mid-scale reading.

A maximum-sensitivity-range for most accurately reading signal strengths below 50-60 microvolts is available with the range switch in MANUAL GAIN CONTROL position. A maximum sensitivity calibration has been made for full scale reading with the manual control turned to maximum clockwise position. (Zero ohms on the variable potentiometer and max. I.F. gain.) With these settings of the controls, signal strength is read as a percentage of the "maximum sensitivity" figure given on the calibration chart with each meter.

SECTION III

OPERATION

1. POWER CONNECTIONS

(a) AC—Connect the meter to a source of 117 volts 50/60 cycles AC. Accuracy when used at 105 to 125 volts will be affected a maximum of ± 1½ DB.

2. READING SIGNAL STRENGTH

(These instructions are duplicated on the calibration card furnished with each instrument.)

"READING SIGNAL STRENGTH"

(a) Check mechanical zero of meter.

(b) Turn power switch to ON. Allow 5 minutes warm-up. (Note:—30 minutes preferred.)

(c) Check electrical zero of meter. Adjust *Meter Zero* knob if necessary.

(d) Set *Function Switch* to *Signal Strength* position.

(e) Select approximate *Range-In-Microvolts* position. In unknown signal strength areas start with highest range (30,000 microvolts). Proceed as described in (f) through (h) below. Adjust Range-In-Microvolts position to give an indication on the meter.

(f) To obtain readings higher than 30,000 microvolts, switch *IN* one or both *Attenuator* switches. Each switch multiplies reading by a factor of *10 times*. Both switches *IN* multiplies reading by a factor of *100 times*.

(g) Connect antenna lead or source of signal to be measured to *Ant. Input*.

(h) Adjust *Tuning* control to desired signal. Tune for maximum meter indication. (Note:—Red line above channel indicates picture carrier; black line indicates sound carrier; relative locations only.)

(i) Adjust *Tuner Compensator* knob for frequency to be measured by referring to chart.

(j) Read signal direct from face of meter.

(k) When using the 300-75 ohm matching transformer, multiply dial readings by two (2).

3. MEASURING PERCENT MODULATION

(These instructions are duplicated on the calibration card furnished with the instrument.)

"READING % MODULATION ON FM SOUND CARRIER (OVERLOAD CHECK)"

(a) Turn *Range-In-Microvolts* switch to Manual Gain control.

(b) Tune signal to FM sound carrier as outlined — "(Reading Signal Strength (a) through (h))."

(c) In *Signal Strength* position of *Function Switch* adjust *Manual* control to read as follows:

For 0 to 10% Mod. Scale (*) microvolts on 100 microvolt scale.

For 0 to 30% Mod. Scale (*) microvolts on 300 microvolt scale.

Note: For this measurement the *Tuner Compensator* may be used as a fine adjustment for the *Manual* control.

* Values given on instrument calibration card.

(d) Place *Function Switch* in % Mod. position and read directly the modulation level as a percentage of full scale reading.

Note: The tuning of the carrier is very critical and can be checked at this point. If the tuning control is varied slightly, either side of the "mean" frequency, the meter will react, noticeably varying with the modulation. When correctly tuned, the needle will drop to a minimum or zero.

When checking overload of amplifiers, using an antenna signal or a re-amplified antenna signal, first measure the % Mod. of the "air" signal itself. Some transmitted FM carriers contain a certain percentage of AM. Check the amplifier and record the difference between the two readings, to determine the % Mod. contributed by the amplifier itself.

4. USING THE DB AND DBJ SCALE

As was explained previously, the Model 704-B is calibrated to measure signals directly in microvolts. An added convenience is the "DB" scale on the meter that is used in conjunction with the "DBJ" scale on the range switch. With a reference of "O DBJ" equal to 1000 uv (a convenient reference established for television signal strength measurements) any signal may easily be measured in DB above or below this reference.

For Example—a 600 microvolt signal is to be measured; the range switch is turned to the 0-1000 uv (or –10 dbj) range and the signal read directly as 600 uv (or as +5.5 DB) on the DB scale. Using +5.5 DB on the –10 dbj range we have a resultant of —4.5 DBJ. Referring to the conversion chart "DB and DBJ to Microvolts" on page 17 it will be seen that –4.5 DBJ is equal to 600 uv. Any signal may be measured in this manner.

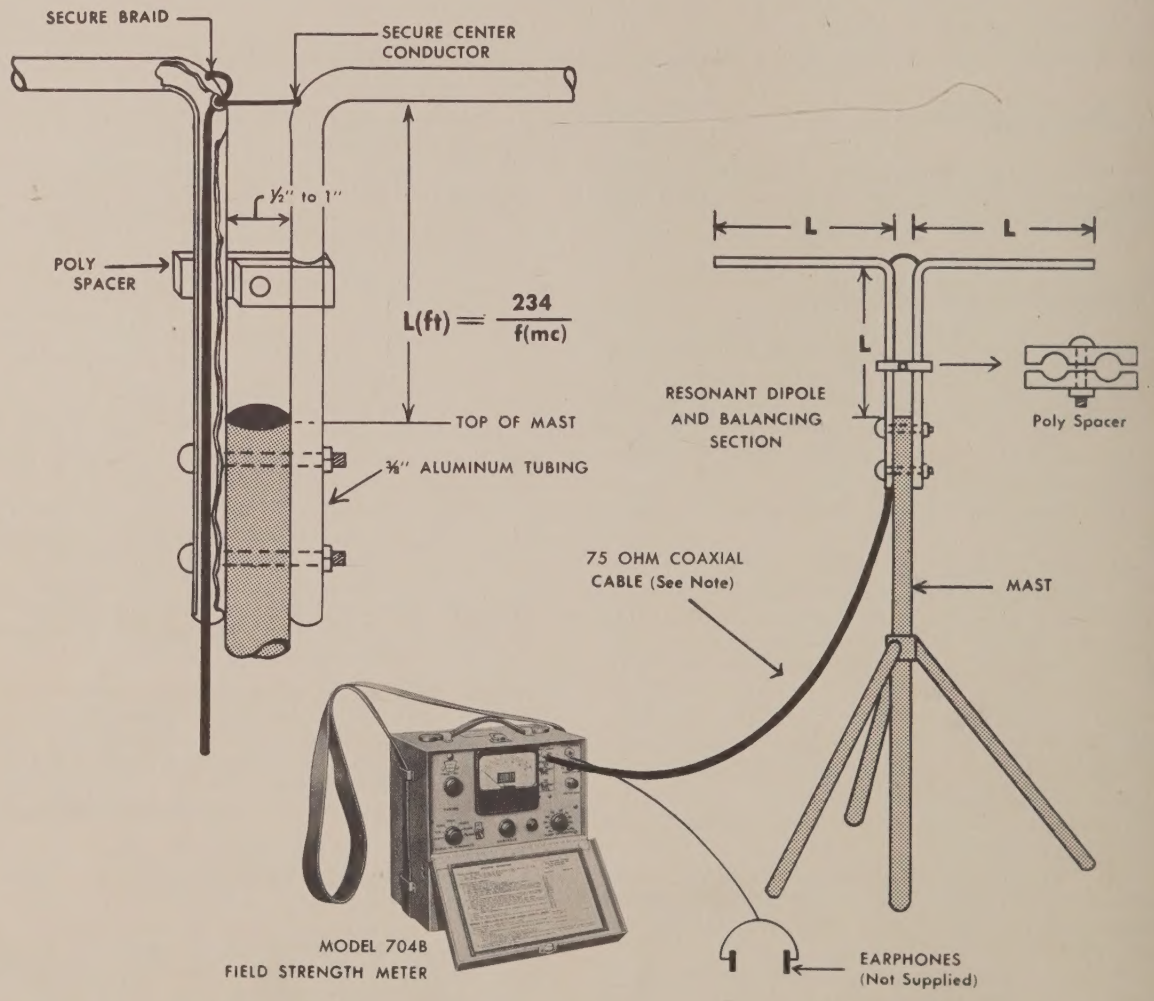
The "DB-dbj" method is very useful in setting (or checking) the gains of amplifiers.

For example—Consider two amplifiers connected by a coaxial cable with a total attenuation loss of 44 DB. The input of the first amplifier is +10 DBJ (3,000 uv) and it is desired to maintain the same input to the second amplifier. With 44 DB loss in the cable and a desired +10 DBJ input to the second amplifier, the output of the first amplifier must be 54 dbj (44 db +10 DBJ = +54 DBJ).

To set the amplifier to 54 dbj turn the "Range in Microvolts" selector to the +10 dbj position and add the two (2) 20 DB input attenuators. This now places us on the +50 db measuring range.

To set the amplifier output to +54 dbj requires only setting the output of the amplifier to give a +4 db reading on the meter scale.

FIGURE 3. MODEL 704B USED AS FIELD INTENSITY METER



Instructions

(See "Applications" on Opposite Page)

1. Read voltage "E" on Meter, in (uv) microvolts.
2. Convert "E" to Field Intensity (E_f) by formula, $E_f \left(\frac{uv}{meter}\right) = .021 \times E \times f\ (mc)$
3. Compensate results for cable losses.

NOTE: RG-59/U should be fitted with Jerrold Male Connector, Model C-52. The C-52 fitting requires crimping with Jerrold Crimping Tool Model PL-601. Adapters are available from Jerrold for use with other types of cable.

APPLICATIONS

The Model 704B Field Strength Meter has many valuable applications:

1. FIELD SURVEYS

Field signal surveys, to determine the best area for receiving signals, are easily made with the Model 704B and an antenna. For extensive field surveys, the Model 704B can be used in conjunction with a small TV receiver for monitoring the pictures. This unit may also be used with recording type voltmeters. Refer to Jerrold Signal Survey Manual.

2. MOBILE FIELD INTENSITY SURVEYS

The Model 704B can easily be mounted in a station wagon, truck, or helicopter, with a resonant dipole and mast, for plotting signal intensity at various distances from transmitters; thus obtaining field-intensity contour maps of television or FM transmitters.

While the Model 704B is ordinarily used as a two-terminal voltmeter to read directly in microvolts, it can easily be used to read uv/meter with the aid of a conversion chart. The requirements when using the instrument in a field intensity (uv/meter) survey are:

a. Use a matched, resonant dipole, oriented to the desired station. (See Figure 3.)

b. Read signal strength in microvolts in the usual manner. Change readings to uv/meter by this formula:

$E_f = .021 \times E \times f$

where E = meter reading in uv

f = frequency in mc/sec.

and E_f = field intensity in uv/meter

Applying the formula to obtain conversion factors for the VHF Television Channels we obtain the chart below:

c. Readings should be corrected for transmission line loss.

d. If Antennas other than dipoles are used, the conversion factor must be *divided* by the gain-factor of the antenna used relative to a dipole.

TV Channel	2	3	4	5	6	7	8	9	10	11	12	13
Multiply meter readings by these factors to obtain uv/meter	1.20	1.32	1.45	1.66	1.78	3.70	3.84	3.96	4.10	4.22	4.35	4.47

3. BOOSTER COMPARISON CHECKS

Boosters are checked to determine their gain-bandwidth characteristics, which can be compared with results from other boosters. By using the same antenna for all tests it is simple to evaluate the merits of various models.

4. CHECKING RADIATION LEVEL OF CABLE AND EQUIPMENT

If equipment or cable is suspected of signal radiation, any leakage signals are measured quite easily with a simple dipole and Model 704B.

5. CHECKING ANTENNAS

Polar characteristics as well as frequency characteristics of antennas are plotted with the aid of the Model 704B. By measuring antenna signal levels over the band, it can be readily determined whether an antenna has a broad or narrow band width. Relationship between picture and sound carrier levels can be measured, and results used in determining amplifier and AGC equipment requirements. Various antenna arrays can be evaluated for gain and bandwidth.

6. CHECKING RANDOM NOISE LEVELS AND INTERFERENCE

Again, a simple dipole and Model 704B are used to check noise levels, (automobile ignition, diathermy, electrical disturbances, etc.) The approximate frequency of the interference can be determined on the frequency dial. By "walking" the meter, the location of the interference can be found. (Take measurements at two locations—lines drawn to the interference source from the two dipole locations will intersect at the source. Measure or pace the distance between the two locations and find the source location by trigonometry.)

7. CHECKING SPURIOUS RF SIGNALS CAUSING INTERFERENCE

Interference beats can be localized, and the frequency and efficiency of trapping circuits evaluated. The Model 704B is used to correctly tune traps, by using the meter reading as an indication of maximum trapping effect.

8. BALANCING MASTER ANTENNA SYSTEMS

The entire System can be balanced and correct signal levels established at all amplifiers. Any amplifier can be checked for an overload condition.

9. AM DISTORTION OF FM AND RF AMPLIFIERS CAN EASILY BE CHECKED

The % amplitude modulation present on the FM carrier is indicated by the Model 704B.

10. LOSS OF ATTENUATORS

DB loss of attenuators, splitting networks, decoupling units, etc., are checked by measuring the level of signals at the input and output of each unit—DB loss is read directly on the meter without calculations.

11. CALIBRATION OF SIGNAL GENERATORS

Output levels of signal generators can be quickly determined and the output attenuator calibrated in microvolts.

SECTION IV

MAINTENANCE

GENERAL

The components used in Model 704B Field Strength Meter have been selected and tested to provide long trouble-free operating life. It must be recognized however, that trouble may be expected at some time during the life of the instrument. This section is included to provide necessary information for the location and correction of such trouble.

DRAWINGS AND PARTS LISTS

The schematic of the circuit located on the last page gives the circuiting and component values. A list of parts with their descriptions accompanies the schematic diagrams. See pages 14-17.

WARRANTY

The Jerrold Field Strength Meter Model 704B is guaranteed against defective workmanship and materials for a period of 90 days from date of sale. Should any defect develop from these causes within the warranty period, we will promptly repair or replace any instrument upon our inspection of the equipment.

In order for the guarantee to be effective, it is necessary that the enclosed warranty card be properly filled out and mailed to the factory immediately upon receipt of the equipment. A record of every instrument is kept in our files. The serial number of the instrument must be given on the card.

SERVICE

In the event you feel the equipment is not functioning properly, you should immediately contact our Instrument Service Department, mentioning the serial number and outlining all characteristics of the failure. Information will be promptly given as to how to correct the failure, or authorization will be given to return the equipment to the factory.

All equipment returned to us should be shipped, carefully packed, via express prepaid; in addition, equipment should be identified with a tag. Unidentified equipment is a serious source of errors and delays.

REPLACEMENT PARTS

Always give model and serial number of the instrument, and part and symbol number of the part, when ordering replacement parts.

FIELD MAINTENANCE

A study of the Model 704B schematic, and familiarity with the theory of operation of this instrument, should enable the user to maintain this instrument in peak condition throughout its service life.

DEFECTIVE COMPONENTS

Defective components can be isolated by use of the schematics, parts list and tube-voltage chart on pages 13-17. No repair or alignment of the tuner, other than the output mixer transformer, should be attempted.

SENSITIVITY (Pre-Calibration Test)

A sensitivity check is a good indication of the proper operation of the instrument and of any need for re-alignment. (See Sensitivity Test Procedure, Page 9.)

ALIGNMENT

The I.F. Section is synchronously tuned and peaked at 25 mc. Field alignment can be easily made if the proper equipment is available. (See Alignment Test Procedure Page 10.)

RECALIBRATION

A routine calibration check of the instrument can be made two or three times a year, or whenever calibration is in doubt—the equipment required is the same as used for the Sensitivity Test. (See Recalibration Test Procedure, Page 11.)

TEST

Equipment

SIGNAL GENERATOR

A good quality RF signal generator with a calibrated output attenuator is used for both the Sensitivity Test and Recalibration of the Model 704B. Signal generators, such as the General Radio Model 1021-AV, Measurements Corp. Model 80, Hewlett Packard Model 608A, Boonton Radio Model 202B, or equivalent, are entirely satisfactory.

Remember that the accuracy of the Field Strength Meter depends on the accuracy of the calibration standard. It is important that the output impedance of the Signal Generator match the input impedance of the Model 704B, which is 75 ohms. Most Signal Generators have 52 ohm outputs and we recommend the use of a fixed-loss matching pad at the output of the generator as shown on Fig. 4.

The loss of the pad must be considered when setting the output level of the generator.

Remember also, that most Signal Generators are calibrated to work into an open circuit. When connected to a matched load impedance, the actual signal at the load is ½ the dial setting on the Signal Generator—this factor has been considered in specifying signal outputs in Test Procedures.

The Signal Generator required for I.F. alignment must have a 25 mc output.

No additional equipment is necessary for the testing of the Model 704B. It is advisable to have a variable voltage transformer to adjust the line voltage at the test bench to 117V AC.

(To remove chassis from cabinet: 1. Remove Power Supply and Plug. 2. Remove screws holding front panel. 3. Remove screws from the rear of cabinet. 4. Lift chassis out carefully.)

Procedure

SENSITIVITY

1. Adjust line voltage to 117V AC.
2. Plug in Model 704B, and allow to warm up for about 30 minutes.
3. Switch both attenuators "IN".
4. Set *Range* switch on Model 704B to MANUAL GAIN CONTROL Position. MANUAL control in minimum gain position (full counter-clockwise).
5. *Function Switch* to *Signal Strength* Position.
6. Set *tuning* dial of Model 704B to Channel 2 picture.
7. Set *Tuner Compensator* to setting for Channel 2 (given on chart with meter).
8. Connect the Signal Generator Output through the proper Matching pad (if needed), to the 75 ohm antenna input on the Model 704B.
9. Tune Signal Generator for peak indication on Meter; use MANUAL control to keep needle on scale.
10. Calibrate Signal Generator and adjust Output to 100 uv.
11. Switch "Out" both attenuators.
12. Turn MANUAL Control to maximum clock-wise position (maximum gain setting).
13. Adjust output of Signal Generator until Field Strength Meter reads "100" on the 0-100 scale.
14. Read output setting of the Signal Generator:
    a. If no matching pad is used, divide Signal Generator reading by two (2).
    b. If 6 DB matching pad is used, divide Signal Generator reading by four (4).

The final reading in 14a, or 14b, should be less than "100" if Field Strength Meter Sensitivity is within acceptable limits.

If Sensitivity reading is more than 100, the I.F. alignment should be checked.

(I.F. ALIGNMENT PROCEDURE ON FOLLOWING PAGE)

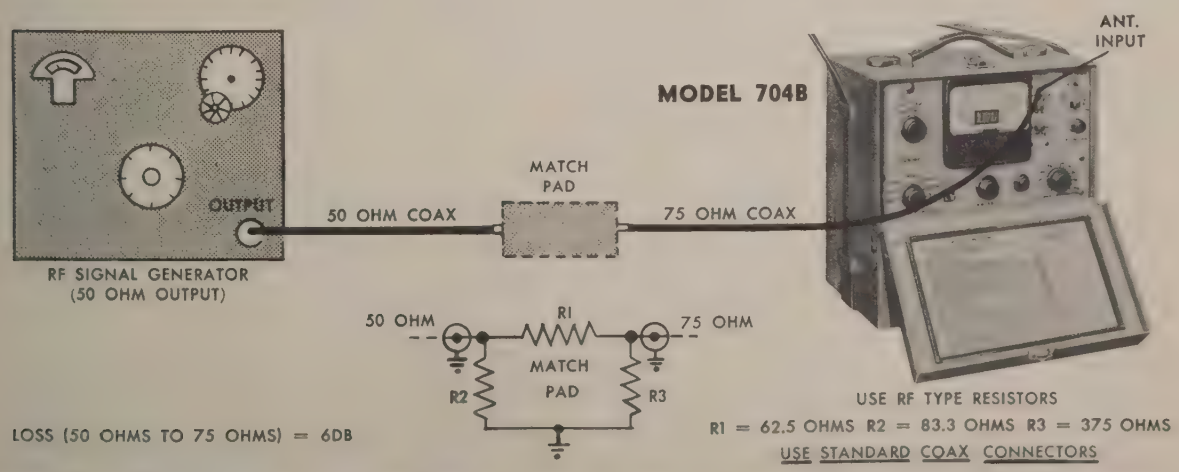


FIGURE 4. CALIBRATION OF MODEL 704B, USING CALIBRATED SIGNAL GENERATOR AS STANDARD

I. F. ALIGNMENT

1. Adjust line voltage to 117V a-c.
2. Set instrument controls as follows:
   a. Range switch to MANUAL GAIN CONTROL.
   b. MANUAL control adjusted for maximum gain (see **note 1, 7a).**
   c. Function switch to "Signal Strength".
   d. Meter zero, adjusted for zero with no signal input.
3. Connect a crystal detector (Jerrold D-85 or similar) from the grid (Pin #1) of V2 (5749) to ground and connect the rectified output of the detector to an oscilloscope.
4. Remove tube shield from the 5654 mixer tube on the tuner. (Center tube)
5. With a coupling jig (Jerrold AJ-106 or similar) couple in over the mixer tube a sweep generator signal with a center frequency of 25 mc **(see note 2, 7c).**

6a. If an internal marker is available from the sweep generator, adjust the marker to 25.0 mc.

b. An external 25.0 mc marker may be used by loosely coupling in with a small loop of wire between the shield and tube of V1 (5749).

7a. Adjust L5 on the tuner and L1 on the I.F. strip to obtain a double tuned flat top response, with the 25 mc marker in the center, and a bandwidth of approximately 1 mc at the minus 1 db level.

Note 1: The setting of the MANUAL control should be adjusted for maximum possible gain without overloading or flattening the response curve.

7b. L2 may be adjusted to have the least loading effect on the response to obtain maximum gain.

7c. The coupling coil on L1 from the tuner is set at the factory and should not require readjustment.

Note 2: In the event that the sweep generator has low output, or the oscilloscope has insufficient gain to obtain a suitable response, the gain of the tuner may be utilized by connecting a sweep generator to the ANT. input of the Model 704B and adjusting the sweep generator and the 704B tuner to approximately Channel 9. Since the RF response of the tuner at the high channels is relatively broad, it will have little effect on the I.F. response. Adjustment of the first I.F. is made as in steps 6b and 7.

8. Remove crystal detector for remainder of I.F. alignment. I.F. coils L2, L3 and L4 are tuned using a 25 mc signal from a signal generator, or the marker oscillator of the sweep generator. The meter swing of the instrument itself serves as the peaking meter.

9a. Connect the signal generator to the ANT. input and remove the 6AB4 oscillator.

9b. Where method 9a does not work, because signal generator has insufficient output to force 25 mc signal through the tuner, remove tube shield from 5654 mixer and loosely couple the generator over the tube with a one-turn loop of wire (or use an AJ-106 coupling jig or similar).

10. With signal generator adjusted for 25 mc output, tune L2, L3 and L4 for peak meter swing, using variable control to keep needle on scale.
    Check the sensitivity of the instrument, which should be about 50 to 80 uv, for a full scale deflection. If sensitivity reads low, check for weak tubes and incorrect voltages.

11. Alignment of the adjacent channel picture and sound traps.
    Connect the signal generator to the mixer tube V-9, thru an AJ-106 (or equivalent). Remove the oscillator tube V-10 and with the signal generator set for an amplitude modulated output of 23.5 megacycles, adjust the generator output control to its lowest possible range that will give a readable (about mid scale) voltage indication on the Model 704B meter scale. Tune the ADJACENT CHANNEL SOUND for minimum indication on the meter. The frequency of the generator should now be set to 26.5 megacycles and the above procedure repeated, tuning the ADJACENT CHANNEL PICTURE trap.

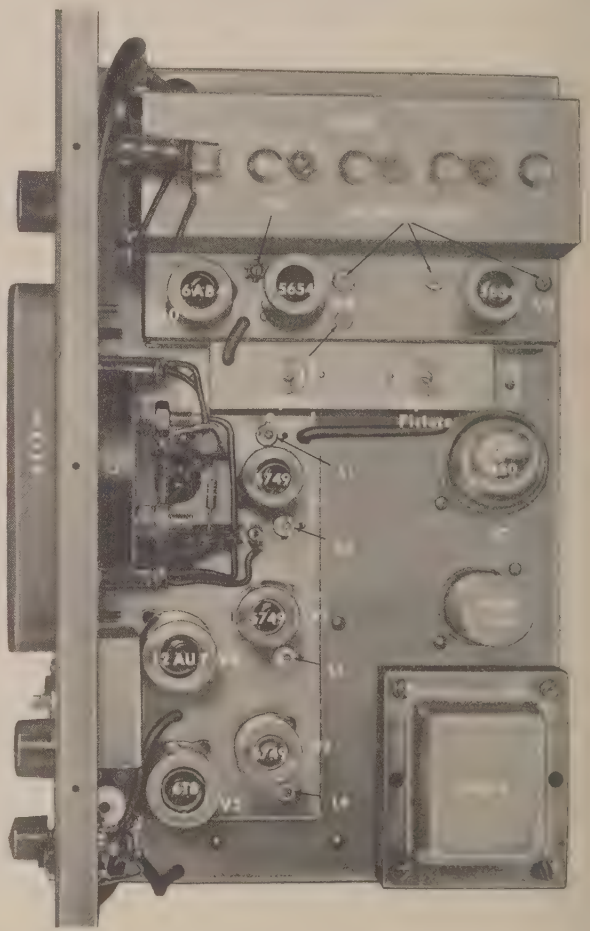


FIG. 5. TUBE AND TUNING CORE LOCATION (TOP VIEW OF CHASSIS)

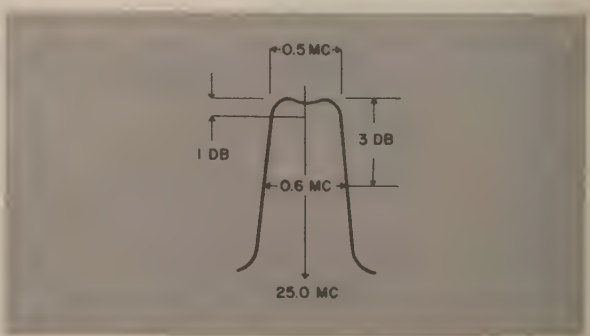


FIG. 5a. OVERALL RESPONSE

RECALIBRATION

RANGE ADJUSTMENT

1. Remove chassis from cabinet and adjust line voltage to 117V AC.

2. Allow instrument to warm up for about 30 minutes.

3. Set instrument controls as follows:
   a. One 20 DB attenuator "IN".
   b. Meter Zero adjustment.
   c. Function Switch in Signal Strength position.
   d. Range Switch in 0-30,000 position.
   e. Tuner compensator set at channel 2 value as given by the calibration chart.

4. Tune Field Strength Meter to Channel 2 picture carrier.

5. Connect Signal Generator to 75 ohm Ant. input of Model 704B, using 6 DB loss match pad if necessary.

6. Tune Signal Generator to 55.25 mc (Channel 2 picture carrier), unmodulated, or for a peak reading on the Model 704B Meter scale.

7. Calibrate Signal Generator.

8. Check Meter calibration at center scale for each position of Range Switch. Settings of Signal Generator and correct readings are given in chart below.

9. Adjust the range potentiometers underneath the chassis to give the proper meter reading in column "3". Each potentiometer is clearly marked with its range designation.

1	2		3	
Meter Range (uv)	Signal Generator		Meter Dial Reading (One 20 DB Attenuator "In")	
	Output Attenuator Setting (uv)	Actual Output (uv)	No External Match Pad	6 DB Match Pad
0-100	1000	500	50	25
0-300	3000	1500	150	75
0-1000	10,000	5000	50	25
0-3000	30,000	15,000	150	75
0-10,000	100,000	50,000	50	25
0-30,000	300,000	150,000	150	75

NOTE: For each change in Signal Generator output level, retune Signal Generator for maximum swing on Field Strength Meter to correct for drift of Generator.

TUNER COMPENSATOR

1. Adjust line voltage to 117V AC.

2. Allow 30 minute warm up period.

3. Set instrument controls as follows:
   a. One 20 DB attenuator "IN".
   b. Check Meter Zero adjustment.
   c. Range switch in "1000" position.
   d. Function Switch in Signal Strength Position.

4. Connect Signal Generator to 75 ohm input of Model 704B, using 6 DB loss match pad if necessary.

5. Calibrate Signal Generator and set output for 10 millivolts. When 6 DB matching pad is used set output for 20 millivolts.

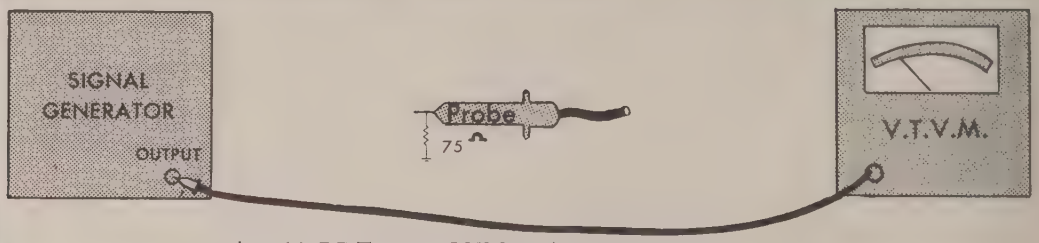
6. Tune Signal Generator and Field Strength Meter to check points specified on calibration chart and listed below.

7. Adjust Tuner Compensator to make meter read "50" on "0-100" scale. Record Tuner Compensator setting for each check points.
   Check Points: Channels 2, 3, 4, 5, 6 Picture Carriers; 90 mc, 110 mc, 130 mc, 160 mc; Channels 7, 8, 9, 10, 11, 12, 13 Picture Carriers.

FIGURE 6 SECONDARY METHODS OF CALIBRATION
RANGE ADJUSTMENT

A. USING SIGNAL GENERATOR AND V.T.V.M.

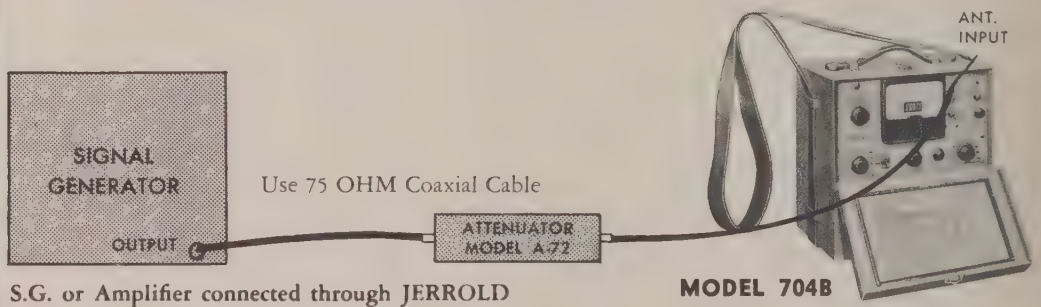
1



Shunt Probe with RF Type 75 OHM Resistor

V.T.V.M. used to calibrate output of S.G. or Amplifier

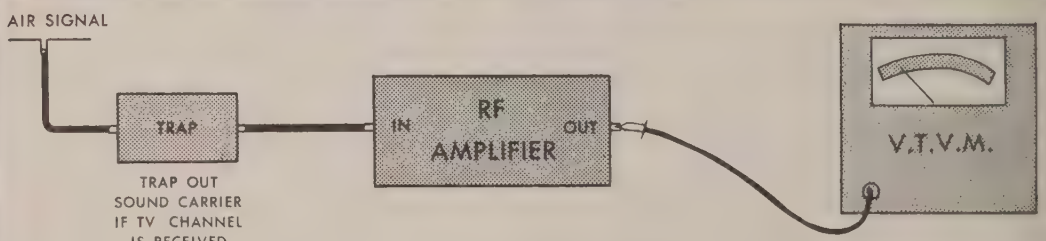
2



S.G. or Amplifier connected through JERROLD ATTENUATOR, A-72, to Antenna Input of Model 704B

B. USING RF AMPLIFIER AND V.T.V.M.

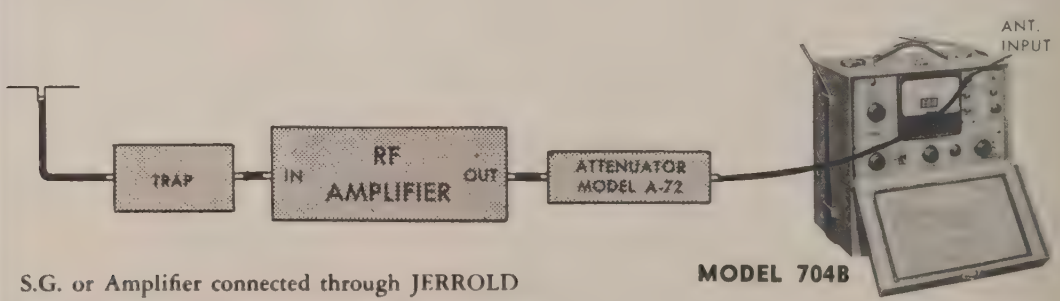
1



RF Amplifier to be Single Channel, capable of 0.5 Volts Output

V.T.V.M. used to calibrate output of S.G. or Amplifier

2



S.G. or Amplifier connected through JERROLD ATTENUATOR, A-72, antenna input on the Model 704B.

VOLTAGE AND RESISTANCE TABLE
FIELD STRENGTH METER MODEL 704B

Measurements made with 20,000 ohm/Volt Meter K = 1000 Ohms

	Pin No.	D.C. Voltage to Ground (Volts)	Resistance to Ground (Power Off) (Ohms)	Control Affecting Reading
V-1 6BA6 5749	1	0	0	
	2	0	0	
	3	6.3V AC	0.1	
	4	0	0	
	5	150	Open circuit after condenser charges.	
	6	145	Open circuit after condenser charges.	RANGE IN MICROVOLTS Set to 1000
	7	7.2	800 Approx.	RANGE IN MICROVOLTS Set to 1000
V-2 6BA6 5749	1	0	6.8K	
	2	0	0	
	3	6.3V AC	0.1	
	4	0	0	
	5	150	Open circuit after condenser charges.	
	6	145	Open circuit after condenser charges.	RANGE IN MICROVOLTS Set to 1000
	7	7.2	800 Approx.	RANGE IN MICROVOLTS Set to 1000
V-3 6BA6 5749	1	0	6.8K	
	2	0	0	
	3	6.3V AC	0.1	
	4	0	0	
	5	150	Open circuit after condenser charges.	
	6	135-140	Open circuit after condenser charges.	TUNER COMPENSATOR
	7	1.5-3	100-300	TUNER COMPENSATOR
V-4 12AU7	1	135	Open circuit after condenser charges.	
	2	—0.4 VTVM	Open circuit after condenser charges.	No Input Signal
	3	7.3	6.1K	
	4	6.3V AC	0.1	
	5	6.3V AC	0.1	
	6	135	Open circuit after condenser charges.	
	7	—0.4 VTVM	1 Meg	
	8	7.3	6.1K	
	9	0	0	
V-5 6T8	1	—0.9 VTVM	2 Meg	
	2	—1.0 VTVM	2.2 Meg	
	3	0	0	
	4	6.3V AC	0.1	
	5	0	0	
	6	—0.9 VTVM	2 Meg	No Input Signal
	7	0	0	
	8	—0.9 VTVM	10 Meg	
	9	90	Open circuit after condenser charges.	
V-6 5V4	1	—	—	
	2	255	Infinite	
	3	—	—	
	4	205V AC	100	
	5	—	—	
	6	205V AC	100	
	7	—	—	
	8	255	Infinite	
V-7 OD3	1	—	—	
	2	0	0	
	3	150	Open circuit after condenser charges.	
	4	—	—	
	5	150	Open circuit after condenser charges.	
	6	—	—	
	7	150	Open circuit after condenser charges.	
	8	—	—	

PARTS LIST

FIELD STRENGTH METER

MODEL 704B

Symbol	*Description*	*Part No.*
Attenuator		
A-1	2 20db Section RF Attenuator	704 A-2
Power Supply		
704B-117V	AC Power Supply & Mounting Assembly	704B-117V
Capacitors		
C-1	22 mmf 600 Volt Ceramic	105
C-2	22 mmf 600 Volt Ceramic	105
C-3	1000 mmf 600 Volt Ceramic	107
C-4	4.7 mmf 600 Volt Ceramic	125
C-5	5000 mmf 600 Volt Ceramic	115
C-6	5000 mmf 600 Volt Ceramic	115
C-7	5000 mmf 600 Volt Ceramic	115
C-8	5000 mmf 600 Volt Ceramic	115
C-9	5000 mmf 600 Volt Ceramic	115
C-10	5000 mmf 600 Volt Ceramic	115
C-11	5000 mmf 600 Volt Ceramic	115
C-12	5000 mmf 600 Volt Ceramic	115
C-13	5000 mmf 600 Volt Ceramic	115
C-14	5000 mmf 600 Volt Ceramic	115
C-15	5000 mmf 600 Volt Ceramic	115
C-16	5000 mmf 600 Volt Ceramic	115
C-17	330 mmf 600 Volt Ceramic	106
C-18	5000 mmf 600 Volt Ceramic	115
C-19	330 mmf 600 Volt Ceramic	106
C-20	15-65 mmf Variable Ceramic	501
C-21	.047 mf 600 Volt Molded Paper	304
C-22	.047 mf 600 Volt Molded Paper	304
C-23	5000 mmf 600 Volt Ceramic	115
C-24	5000 mmf 600 Volt Ceramic	115
C-25A	20 mf 350 Volt Electrolytic	203
C-25B	10 mf 300 Volt Electrolytic	203
C-26	5 mmf 600 Volt Composition	101
C-27	12 mmf 600 Volt Ceramic	136
D-1	Tuner Dial Assembly	704 D-1
DCP-1	DC Vibrator Supply & Mounting Assembly	704A-6V
F-1	1 Amp 3AG Fuse	1202
F-2	10 Amp 3AG Fuse	1205
F-3	10 Amp 3AG Fuse	1205
I-1	#47 Power Pilot Lamp	3305
I-2	#47 Meter Pilot Lamp	3305
I-3	#47 Meter Pilot Lamp	3305
I-4	#47 Tuner Pilot Lamp	3305
J-1	Phone Jack Assembly	1042
J-2	6 Pin Male Jones Plug	1045
L-1	I.F. Tuning Coil Var.	704 L-1
L-2	I.F. Tuning Coil Var.	704 L-2
L-3	I.F. Tuning Coil Var.	704 L-3
L-4	I.F. Tuning Coil Var.	704 L-4
L-5	10 microhenry RF Choke	852
L-6	10 microhenry RF Choke	852
L-7	10 microhenry RF Choke	852
L-8	10 henry Filter Choke	901
L-9	10 microhenry RF Choke	852

Symbol	*Description*	*Part No.*
M-1	Instrument 200 Micro Amp Movement	6549
P-1	6 Pin Female Jones Plug	1046
P-2	6 Pin Female Jones Plug	1046
R-1	15 K ohms ±10% ½W	2459
R-2	6.8K ohms ±10% ½W	2475
R-3	6.8K ohms ±10% ½W	2475
R-4	15K ohms ±10% ½W	2483
R-5	82 ohms ±10% ½W	2429
R-6	82 ohms ±10% ½W	2429
R-7	82 ohms ±10% ½W	2429
R-8	3.9K ohms ±10% ½W	2469
R-9	3.9K ohms ±10% ½W	2469
R-10	3.9K ohms ±10% ½W	2469
R-11	180 ohms ±10% ½W	2437
R-12	180 ohms ±10% ½W	2437
R-13	180 ohms ±10% ½W	2437
R-14	22 K ohms ±10% ½W	2487
R-15	10K ohms ±10% 1W	2479
R-16	500 ohm Var. 1W	3406
R-17	500 ohm Var. 1W	3406
R-18	1K ohm Var. 1W	3405
R-19	5K ohm Var. 1W	3404
R-20	5K ohm Var. 1W	3404
R-21	2.2K ohm ±10% ½W	2463
R-22	5K ohm Var. 1W	3404
R-23	3.3K ohm ±10% ½W	2467
R-24	10K ohm Var. 1W	3403
R-25	500 ohm Var. 1W	3406
R-26	1 meg ohm ±10% ½W	2527
R-27	1 meg ohm ±10% ½W	2527
R-28	1 meg ohm ±10% ½W	2527
R-29	1 meg ohm ±10% ½W	2527
R-30	2.2K ohm ±10% ½W	2463
R-31	2.2K ohm ±10% ½W	2463
R-32	3.9K ohm ±10% ½W	2469
R-33	18K ohm ±10% ½W	2485
R-34	18K ohm ±10% ½W	2485
R-35	10K ohm Var. 1W	2479
R-36	270K ohm ±10% ½W	2513
R-37	10 meg ohm ±10% ½W	2551
R-38	1750 ohm ±10% 20W	2862
R-39	1250 ohms ±10% 20W	2857
S-1	2 Section Rotary 7-P	3715-16-17-18
S-2	DPDT Slide	3720
S-3	SPST Toggle	3701
T-1	Power Transformer	4303
T-2	300-72Ω Transformer	704-300-72
TU-1	Tuner	704-TU-2
V-1	5749 Vacuum Tube	4523
V-2	5749 Vacuum Tube	4523
V-3	5749 Vacuum Tube	4523
V-4	12AU7 Vacuum Tube	4512
V-5	6T8 Vacuum Tube	4513
V-6	5V4G Rectifier	4514
V-7	0D3/VR150 Voltage Regulator	4504

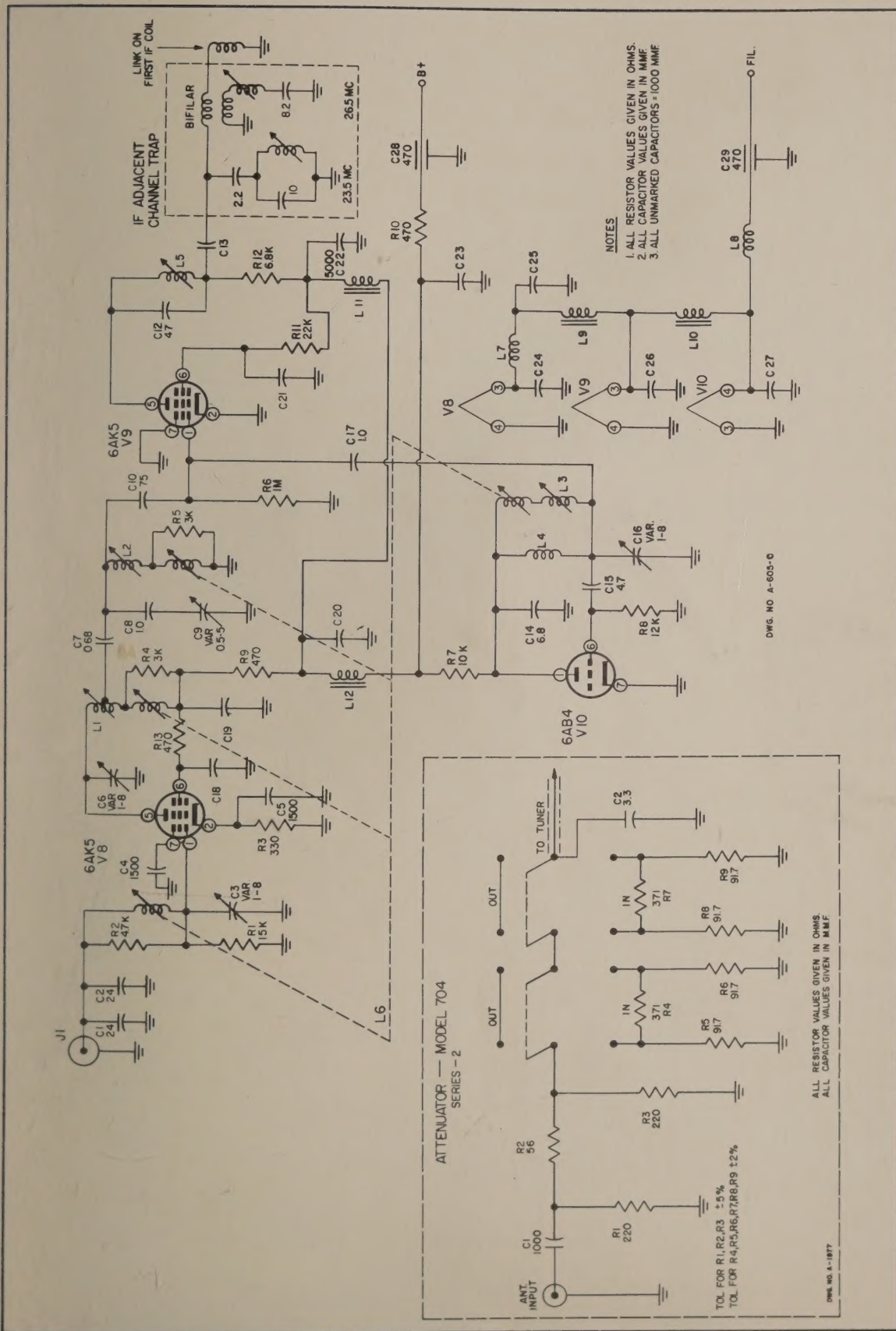
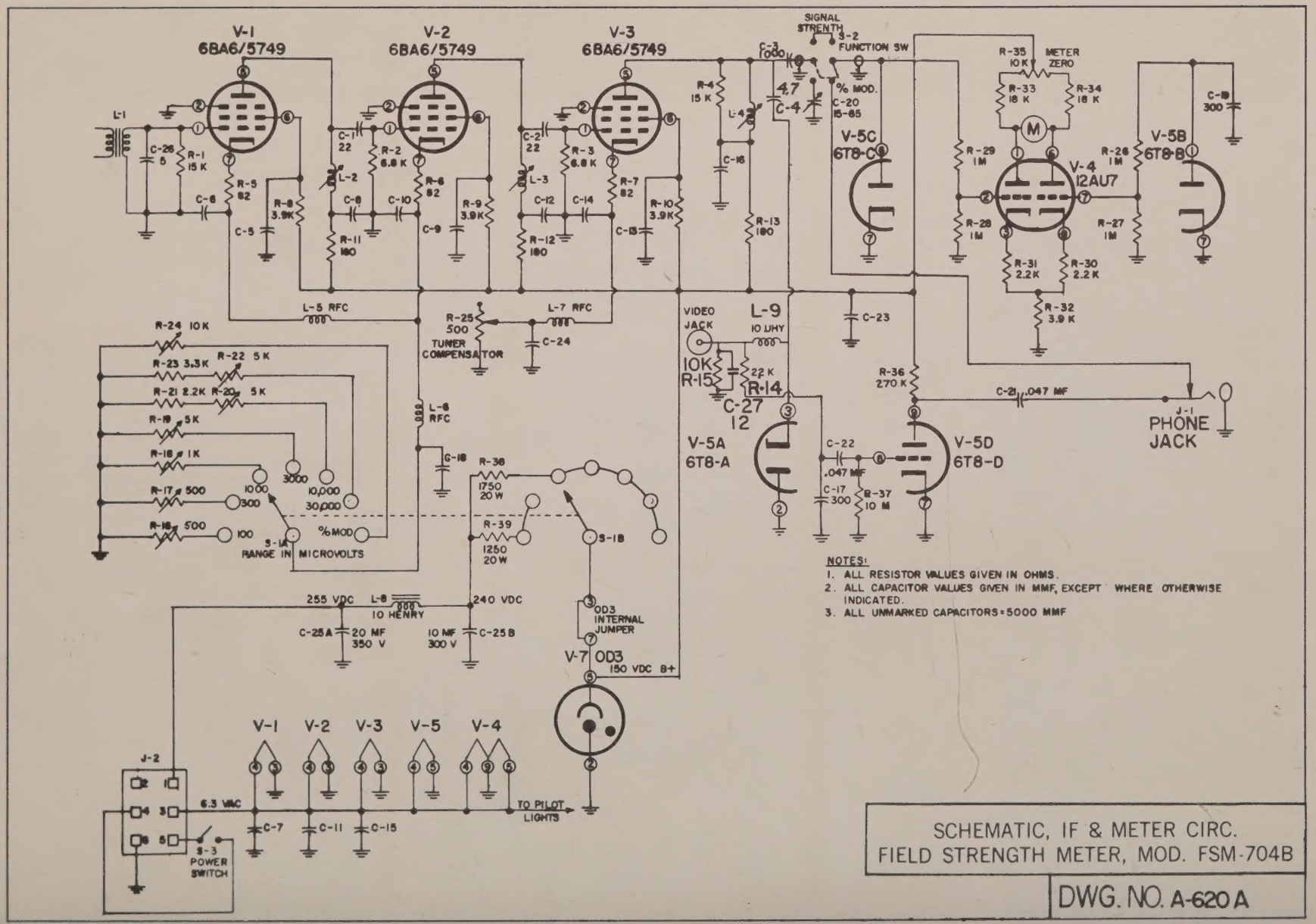

JERROLD TUNER FOR MODEL FSM-704B
IF ADJACENT CHANNEL TRAP
BIFILAR
LINK ON FIRST IF COIL
26.5 MC
23.5 MC
6AK5 V9
6AK5 V8
6AB4 V10
V8
V9
V10
B+
FIL.
NOTES
1. ALL RESISTOR VALUES GIVEN IN OHMS.
2. ALL CAPACITOR VALUES GIVEN IN MMF
3. ALL UNMARKED CAPACITORS = 1000 MMF
DWG. NO A-603-C
ATTENUATOR — MODEL 704
SERIES - 2
TO TUNER
OUT
IN
ANT. INPUT
ALL RESISTOR VALUES GIVEN IN OHMS.
ALL CAPACITOR VALUES GIVEN IN MMF
TOL. FOR R1, R2, R3 ±5%
TOL. FOR R4, R5, R6, R7, R8, R9 ±2%
DWG. NO. A-1977

FIGURE 7.



NOTES:
1. ALL RESISTOR VALUES GIVEN IN OHMS.
2. ALL CAPACITOR VALUES GIVEN IN MMF, EXCEPT WHERE OTHERWISE INDICATED.
3. ALL UNMARKED CAPACITORS = 5000 MMF

SCHEMATIC, IF & METER CIRC.
FIELD STRENGTH METER, MOD. FSM-704B

DWG. NO. A-620 A

FIGURE 8.

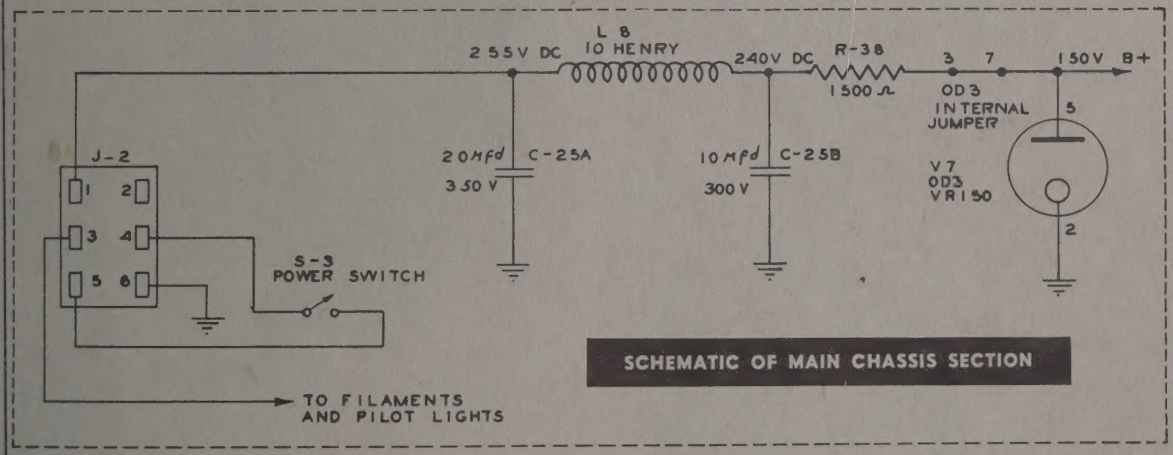
DECIBELS AND DBJ CHART

REF. LEVEL 0 DBJ = 1000 UV ACROSS 72 OHMS

+		−	
60 DBJ	1,000,000 UV	2 DBJ	794 UV
50 DBJ	316,000 UV	3 DBJ	708 UV
40 DBJ	100,000 UV	6 DBJ	501 UV
30 DBJ	32,000 UV	10 DBJ	316 UV
20 DBJ	10,000 UV	12 DBJ	250 UV
18 DBJ	7,943 UV	15 DBJ	179 UV
15 DBJ	5,623 UV	18 DBJ	126 UV
12 DBJ	3,981 UV	20 DBJ	100 UV
10 DBJ	3,162 UV	30 DBJ	32 UV
6 DBJ	1,995 UV	40 DBJ	10 UV
3 DBJ	1,413 UV	50 DBJ	3 UV
2 DBJ	1,259 UV	60 DBJ	1 UV

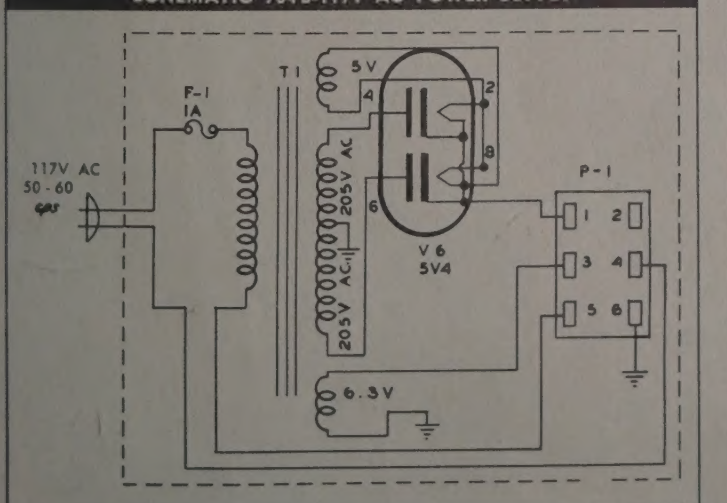
0 DBJ - - - - - - 1,000 UV

Figure 9 Power Supply



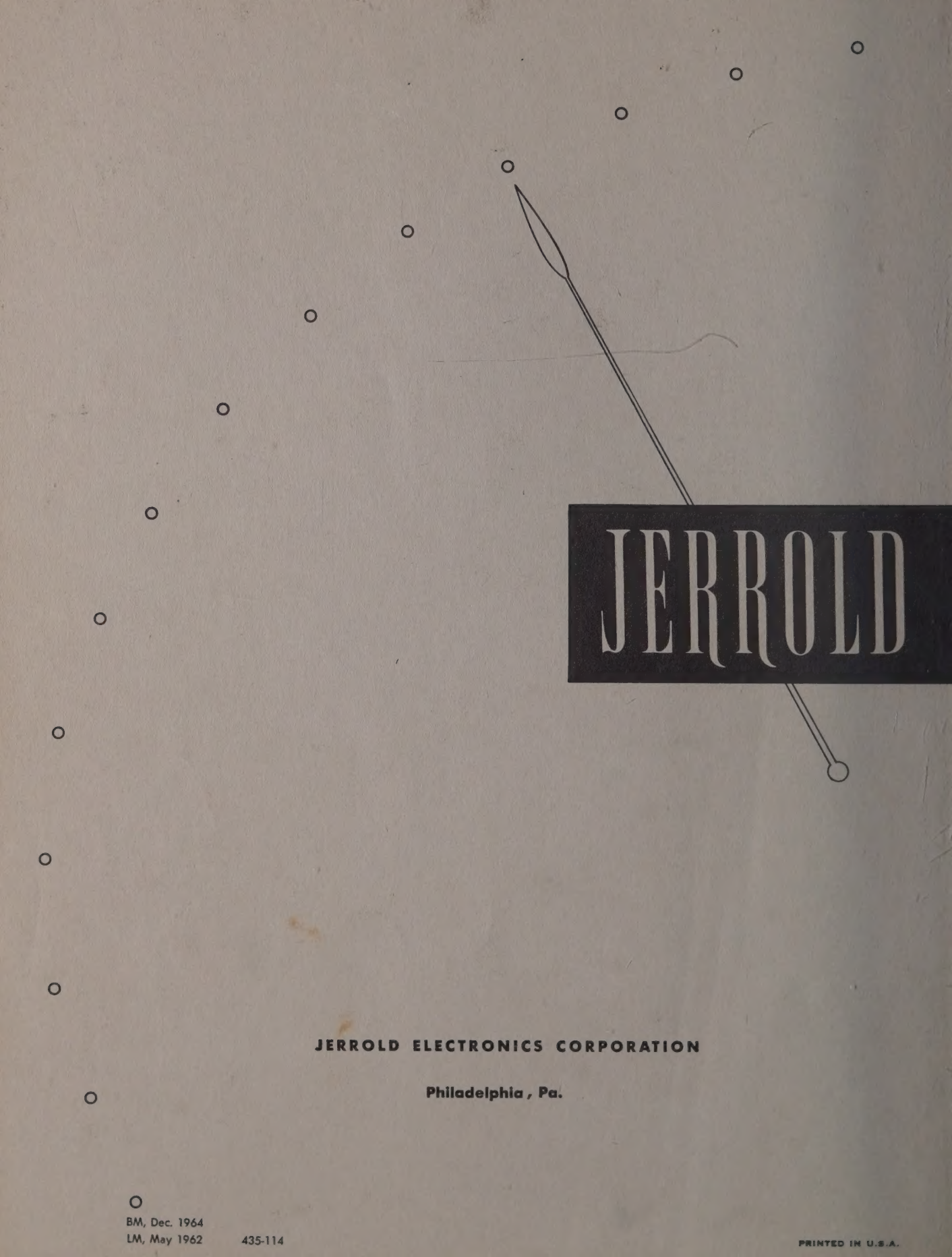
SCHEMATIC OF MAIN CHASSIS SECTION

SCHEMATIC 704B-117V AC POWER SUPPLY



Warranty

The Jerrold Field Strength Meter Model 704B is guaranteed against defective workmanship and materials for a period of 90 days from date of sale. Should any defect develop from these causes within the warranty period, we will promptly repair or replace any instrument upon our inspection of the equipment.



JERROLD ELECTRONICS CORPORATION

Philadelphia, Pa.

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LM, May 1962 435-114

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